Spatial Analysis of Substrate Classification Data for 2002 Keweenaw Bay Survey.

Supplemental Report

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Introduction

During June 2002 an acoustic seabed classification survey was undertaken in the southern portion of Keweenaw Bay, Lake Superior. This was in support of the Conservation Strategy initiative of the Keweenaw Bay Indian Community Natural Resources Department and summarized in the report *Aquatic Substrate Mapping in Support of the Keweenaw Bay Indian Community's Conservation Management Strategies* (Biberhofer, 2002).

The acoustic seabed classification data was resolved into six substrate classes mud/muddy sand, sand, cobble, transition (mixture of cobble and sand), compact sand or fine-on-hard and wood debris. While the distribution of these substrates can be delineated using the classified point survey data, additional analyses were required to determine the extent and amount of coverage each of the substrate types represented both for the study area and the individual study zones.

This report, which is supplemental to the survey report, details the procedures used and summarizes the results of the spatial analyses.

Data Processing

The data for analyses was represented in one (1) table of the classified point data in dBase format with the necessary information to ingest into a GIS system. The Easting and Northing values in the database were used to position the data with respect to other feature types such as shoreline and aerial photographs to ensure that the data was in the correct geographic location. Positional accuracy was excellent and no further adjustment or re-projecting was required of the data.
The information was converted to ESRI® point SHP file for further processing and ease of data sharing with other programs. Data import and conversion was executed using ArcMap 8.2™.

Before any further processing was carried out on the data, a data mask was developed to compensate for the linear and restricted nature of the data there were large areas of the study area that were not represented. This included near shore areas where access

was restricted due to shallow water conditions and/or areas that where very deep. The data mask was generated by from the existing shoreline vector dataset combined with hand-digitized features to form a custom data mask or polygon. The resulting data mask was used further data analysis and spatial clipping.

Data Analysis

Voronoi or Thessien polygons for the study area were used to consolidate adjacent point data of the same "cluster" or substrate information. Voronoi maps are constructed from a series of polygons formed around the location of a sample point. Voronoi polygons are created so that every location within a polygon is closer to the sample point in that polygon than any other sample point. After the polygons are created, neighbours of a sample point are defined as any other sample point whose polygon shares a border with the chosen sample point.

Duplicate points that occurred when transect lines intersected encountered by the program were ignored and not used in any of the statistical calculation. Although data conversion and post processing was conducted using ESRI ArcMap, all data analysis was carried out using ArcInfo™ 8.2. Voronoi polygons were exported from ArcInfo to ESRI SHP format for clipping with the aforementioned data mask.

The Voronoi polygon theme was incorporated into an ArcView GIS project and clipped using the survey data mask. Polygon areas were recalculated using *XTools ArcView© Extension* (Version 6/1/2001). (DeLaune, 2001) The resulting attribute table was exported as a dBase file and imported into Systat to calculate summary statistics.

The Voronoi polygon theme has then clipped to select for each the four study zones, East Shore, West Shore, Pequaming Bay and L'Anse Bay with data mask polygons specific to each of the study zones created using heads-up digitizing. After each clip the selected attribute file was reprocessed using Xtools to ensure area calculations were consistent with clipped boundaries. The attribute files were then exported and summarized using Systat as the original Voronoi polygon theme.

Results

Table 1 is the summary of the spatial statistics for the study area and the individual study zones with substrates totals by column. Percentages of area are consistent with distribution of the point data and are presented in Table 2. Figures 1-5 map the distribution of the substrate polygons.

Discussion:

This procedure provides a means to extract area estimates from the point data coverage. The interpolation procedure used can also be applied to other attributes of the data such as depth and the calculated slope and aspect of the bathymetry data. Combing the substrate polygon theme with other new thematic layers will make it possible to query the data to address specific aquatic habitat questions.

Acknowledgements:

The Voronoi analyses were competed by John Fairs of Golder and Associates under contract to Environment Canada.

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Tables

Area (Hectares)	Cobble	Mud / Muddy Sand	Sand	Sand compact or fine-on-hard	Transition	Wood debris	**Total Area**
East Shore	5	103	151	191	47	2	**499**
L'Anse Bay	7	450	175	99	45	16	**791**
Pequaming Bay	2	186	85	88	20	2	**382**
West Shore	52	154	393	207	47	3	**856**
Study Area	**66**	**893**	**803**	**584**	**159**	**22**	**2527**

Table 1: Substrate types by study zone and study area in hectares.

Percentage	Cobble	Mud/ Muddy Sand	Sand	Sand compact or fine-on-hard	Transition	Wood debris
East Shore	0.9	20.7	30.2	38.3	9.5	0.4
L'Anse Bay	0.9	56.9	22.1	12.5	5.7	2.0
Pequaming Bay	0.6	48.7	22.2	23.0	5.1	0.4
West Shore	6.1	17.9	45.9	24.2	5.5	0.4
Study Area	**2.6**	**35.3**	**31.8**	**23.1**	**6.3**	**0.9**

Table 2: Substrate types by study zones and study as percentages.

Figures:

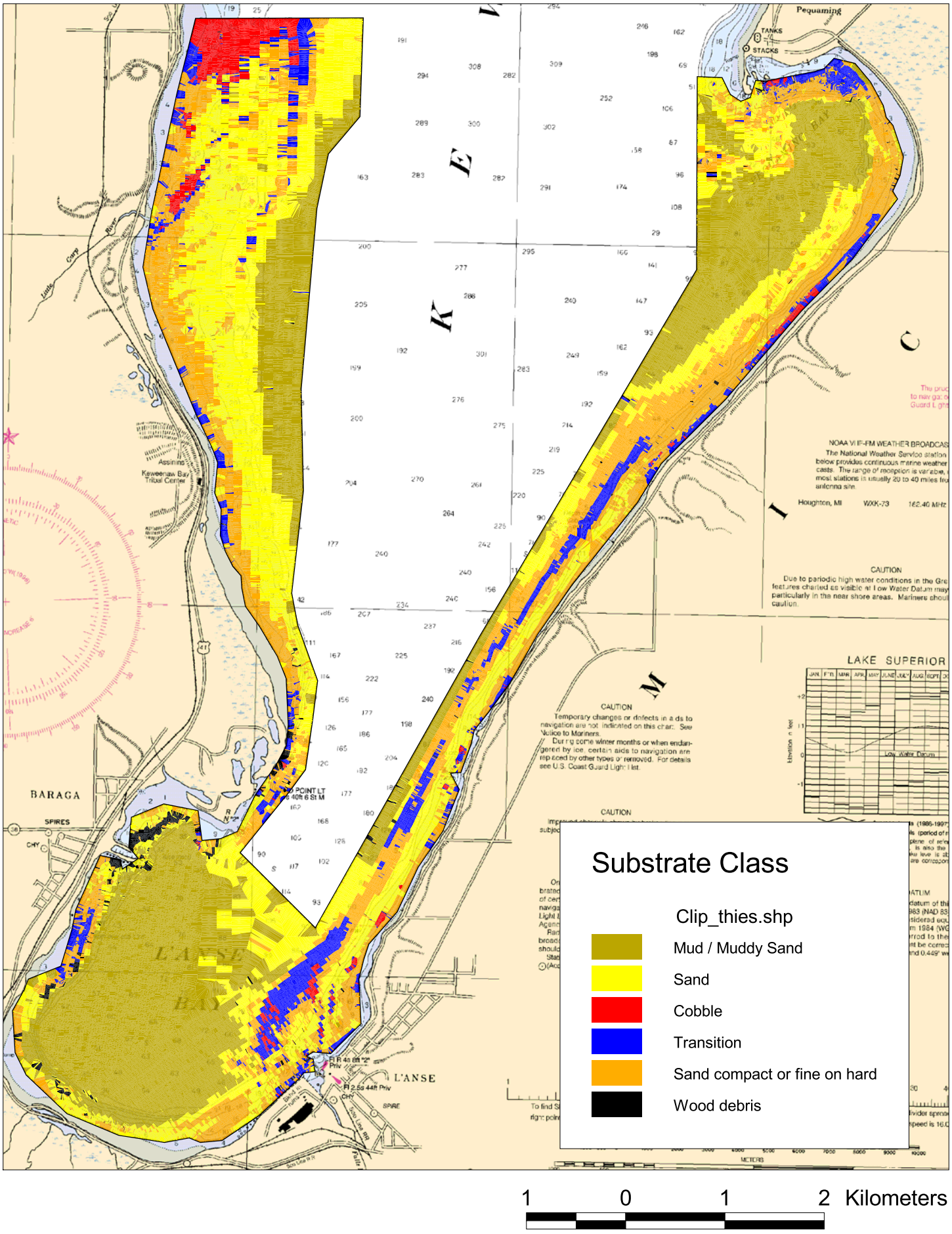

Figure 1: Substrate class polygons for the study area

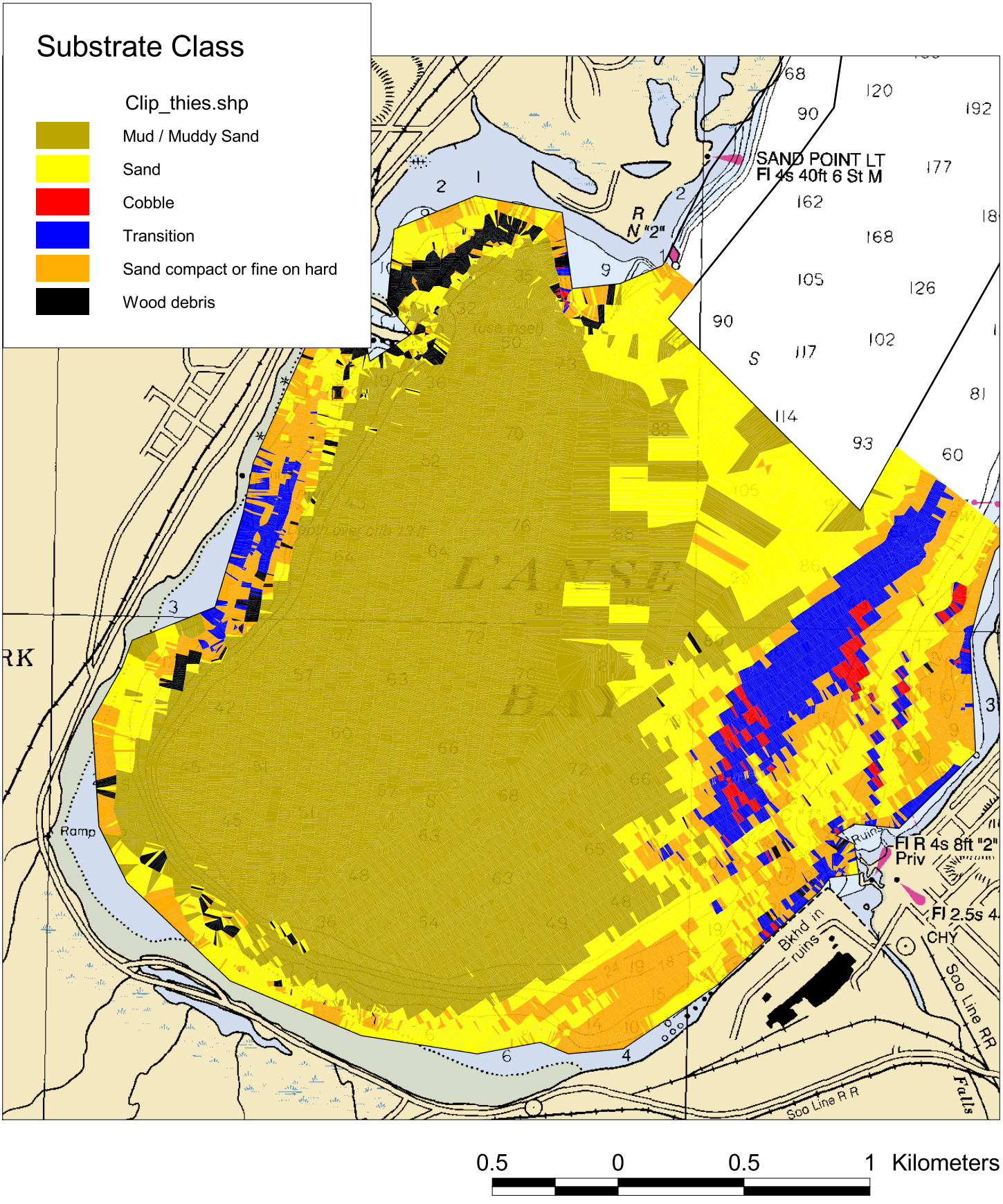

Figure 2: Substrate class polygons for L'Anse Bay study zone

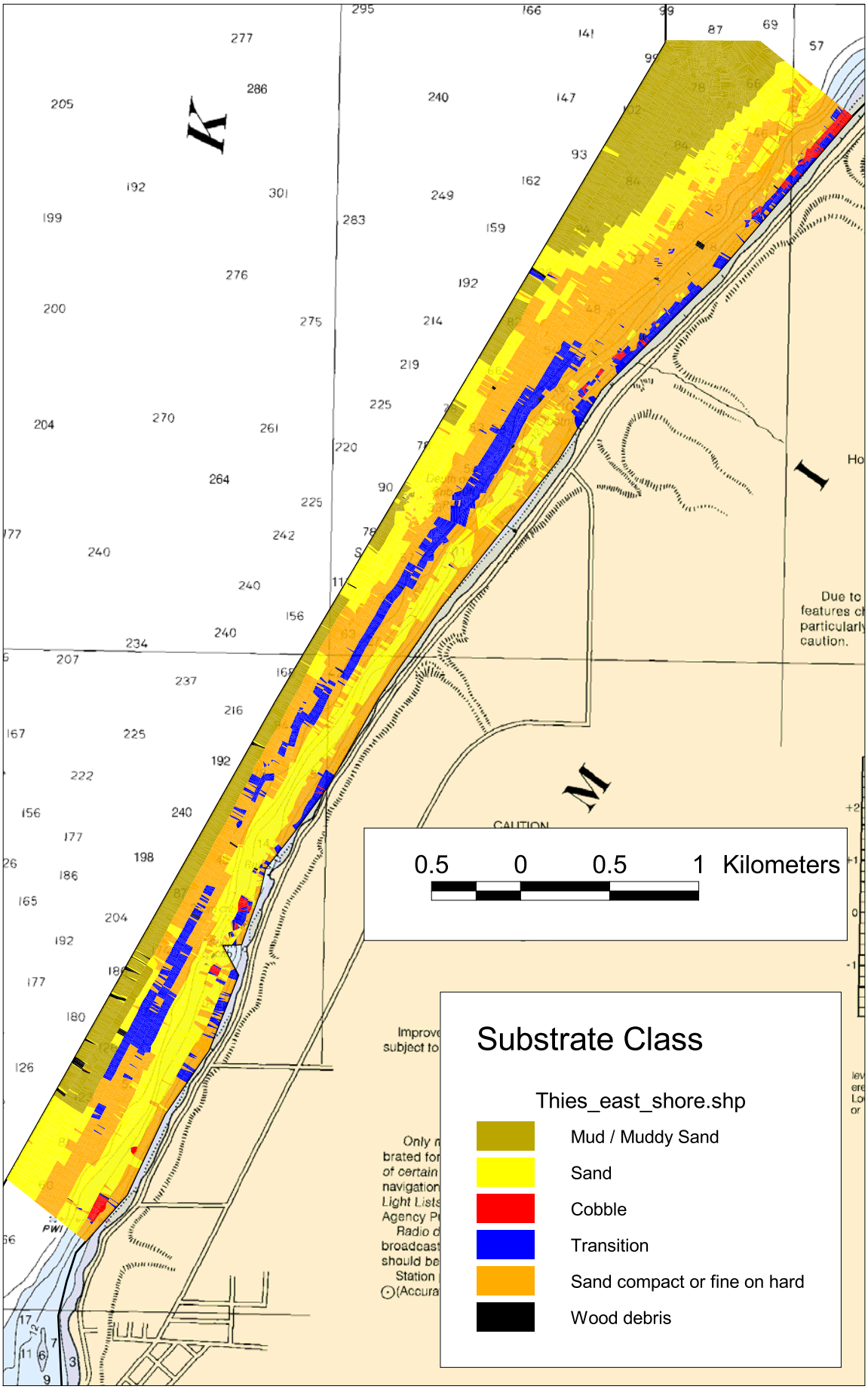

Figure 3: Substrate class polygons for east shore study zone

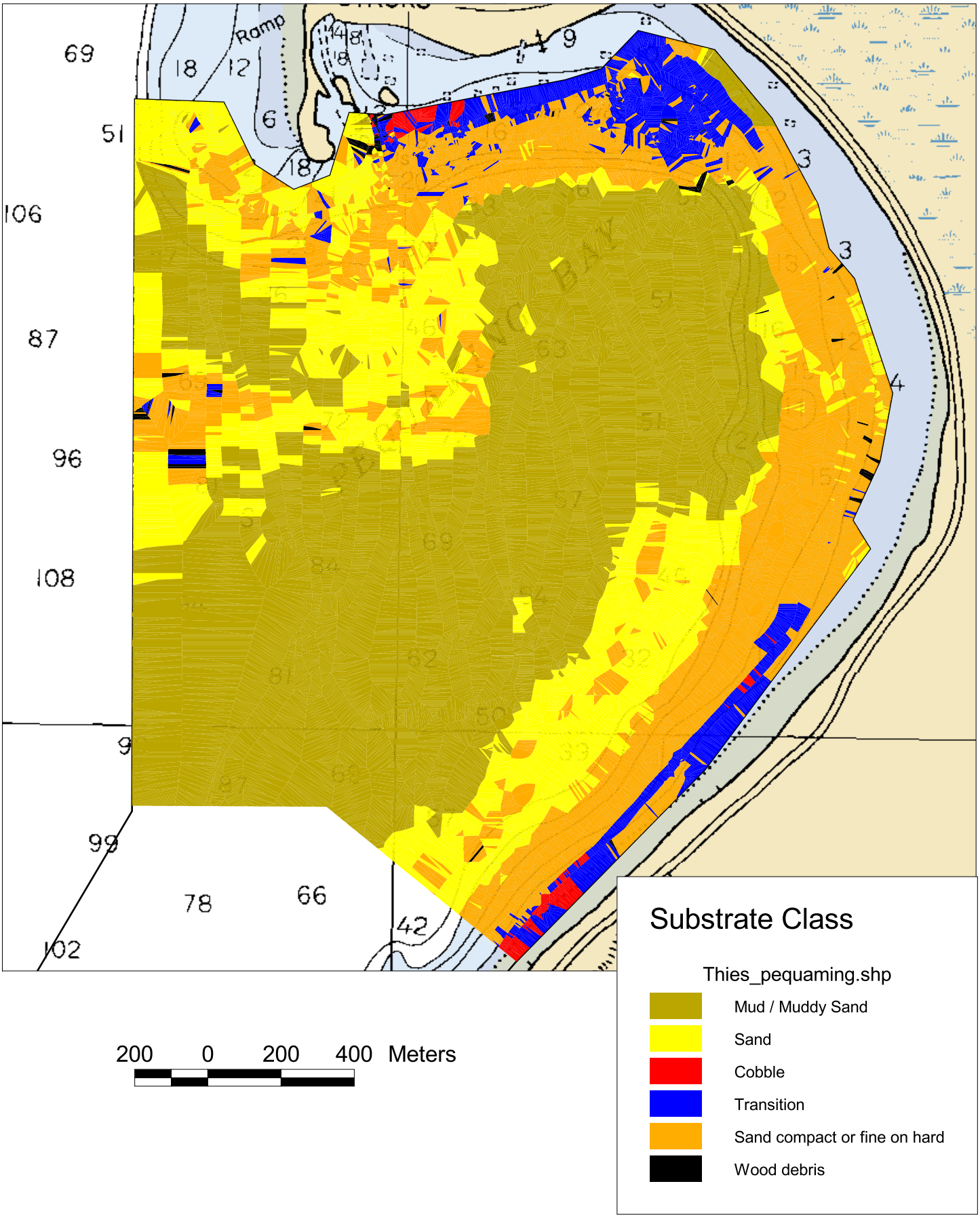

Figure 4: Substrate class polygons for Pequaming Bay study zone

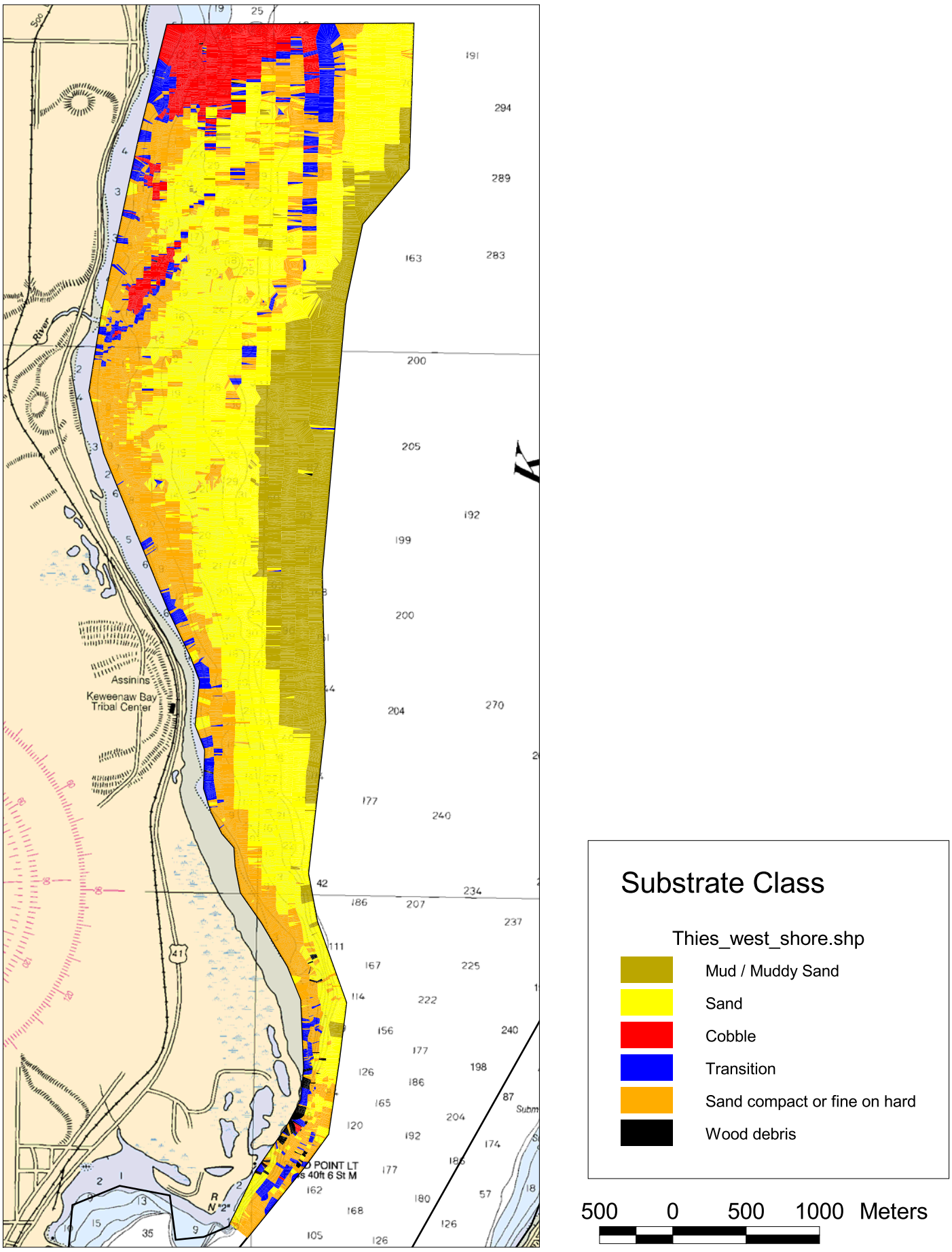

Figure 5: Substrate class polygons for west shore study zone